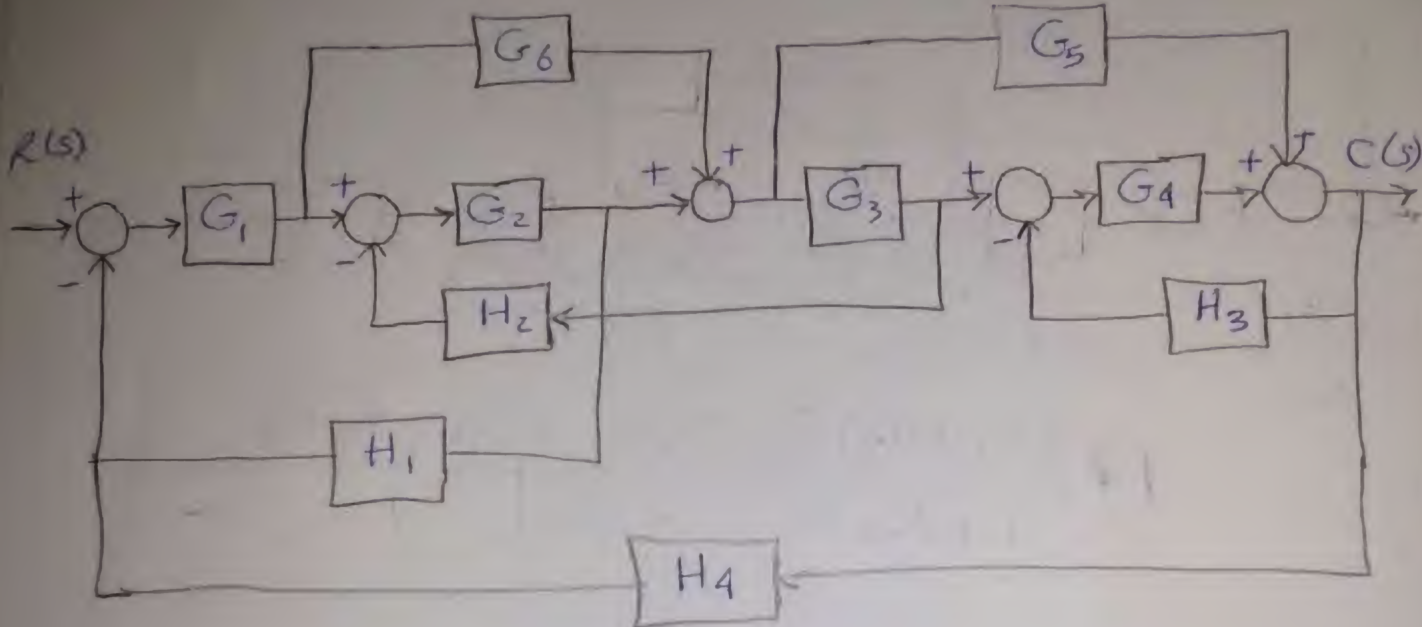
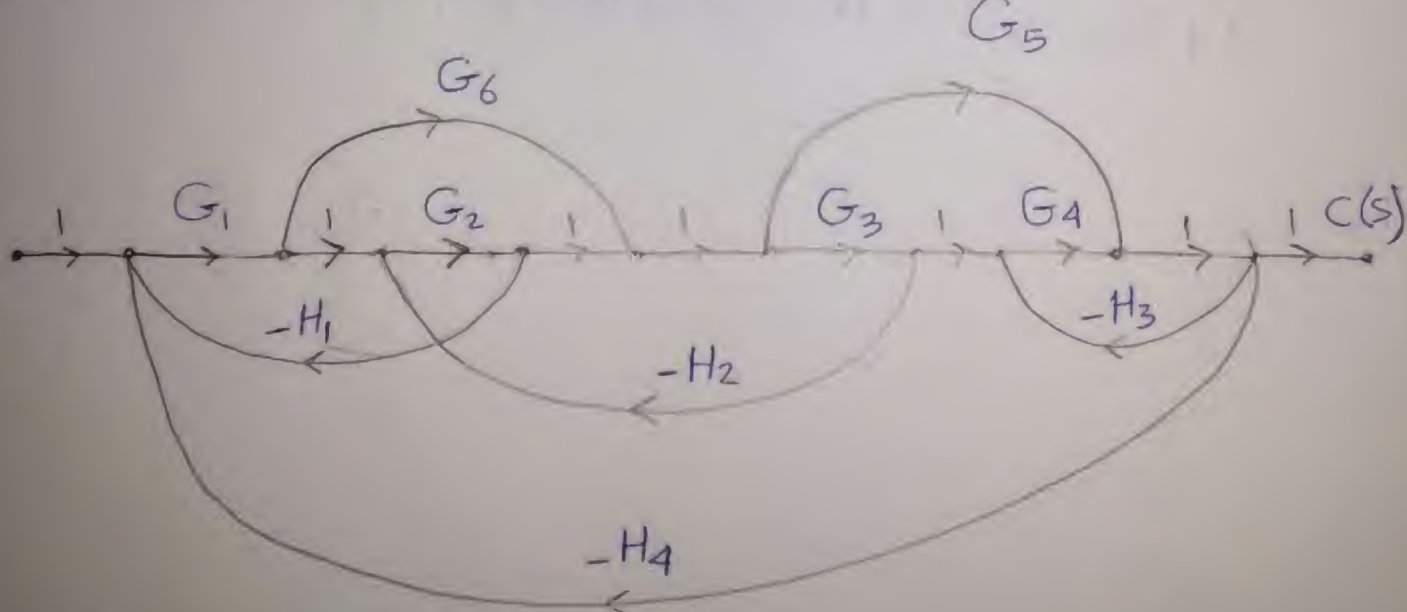
sheet 5

1) use Mason's gain formula to determine the transfer function $C(s)/R(s)$ for the system given:-



Sol



Forward Paths

$P_1 = G_1 G_2 G_3 G_4$, $P_2 = G_1 G_6 G_3 G_4$

$P_3 = G_1 G_6 G_5$ $P_4 = G_1 G_2 G_5$

loops

$L_1 = -G_1 G_2 H_1$ $L_2 = -G_4 H_3$

$L_3 = -G_2 G_3 H_2$ $L_4 = -G_1 G_2 G_3 G_4 H_4$

$L_5 = -G_1 G_6 G_3 G_4 H_4$, $L_6 = -G_1 G_6 G_5 H_4$

* Non touching loops

$L_{12} = G_1 G_2 G_4 H_1 H_3$

$L_{23} = G_2 G_3 G_4 H_2 H_3$

$\Delta = 1 - \sum$ all loops $+ \sum$ non touching loops

$= 1 + G_1 G_2 H_1 + G_4 H_3 + G_2 G_3 H_2 + G_1 G_2 G_3 G_4 H_4$

$+ G_1 G_6 G_3 G_4 H_4 + G_1 G_6 G_5 H_4 + G_1 G_2 G_4 H_1 H_3$

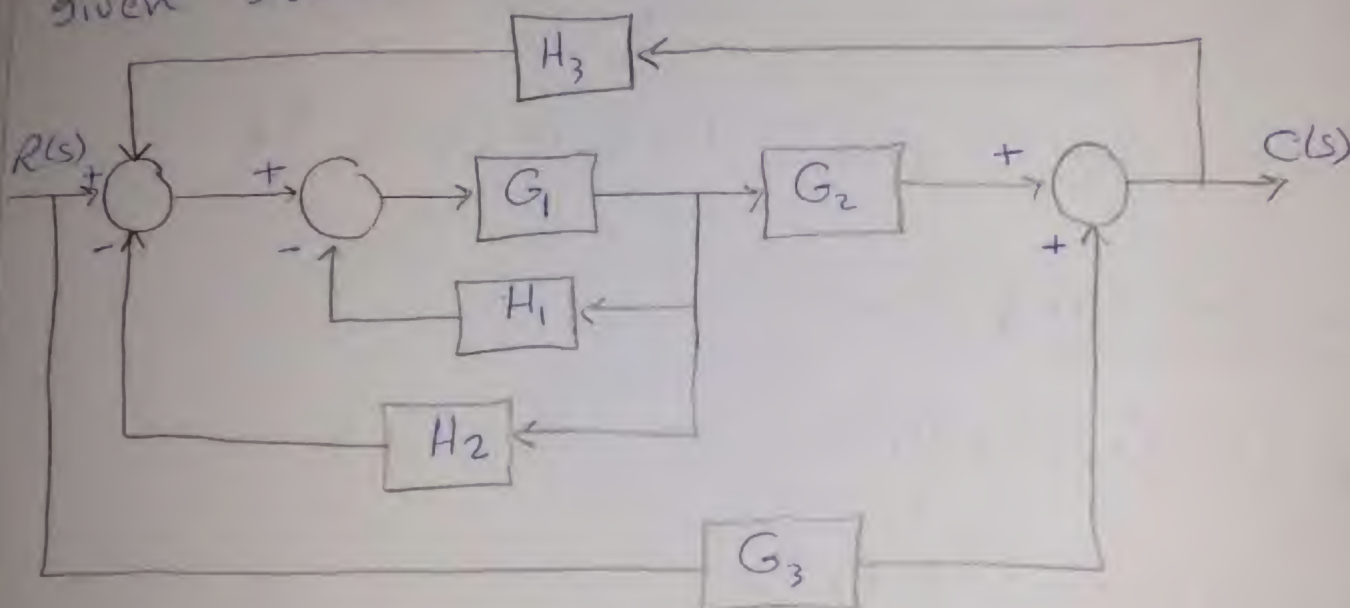
$+ G_2 G_3 G_4 H_2 H_3$

$\Delta_1 = \Delta|_{P_1=0} = 1$, $\Delta_2 = \Delta|_{P_2=0} = 1$

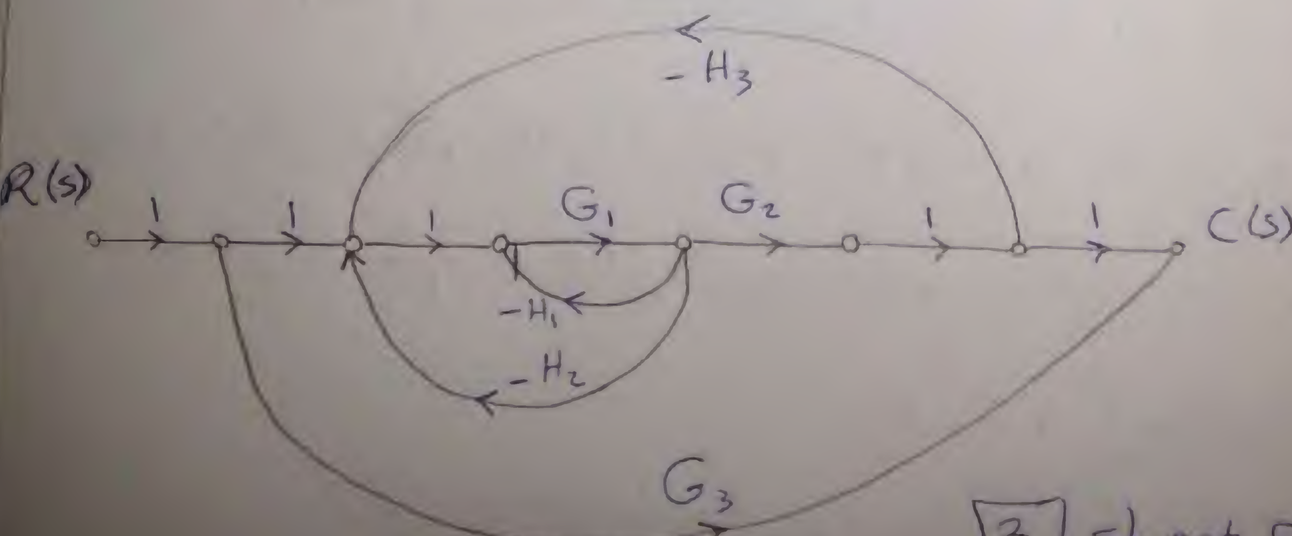
$\Delta_3 = 1$ $\Delta_4 = 1$

$$\frac{C(s)}{R(s)} = \frac{P_1\Delta_1 + P_2\Delta_2 + P_3\Delta_3 + P_4\Delta_4}{\Delta}$$

$\boxed{2}$ use Mason's signal flow technique to find transfer function C(s)/R(s) for the block diagram given below:-



$\boxed{sol}$



$\boxed{3}$ sheet 5

Forward Paths

$P_1 = G_1 G_2$; $P_2 = G_3$

Loops

$L_1 = -G_1 G_2 H_3$; $L_2 = -G_1 H_1$

$L_3 = -G_1 H_2$

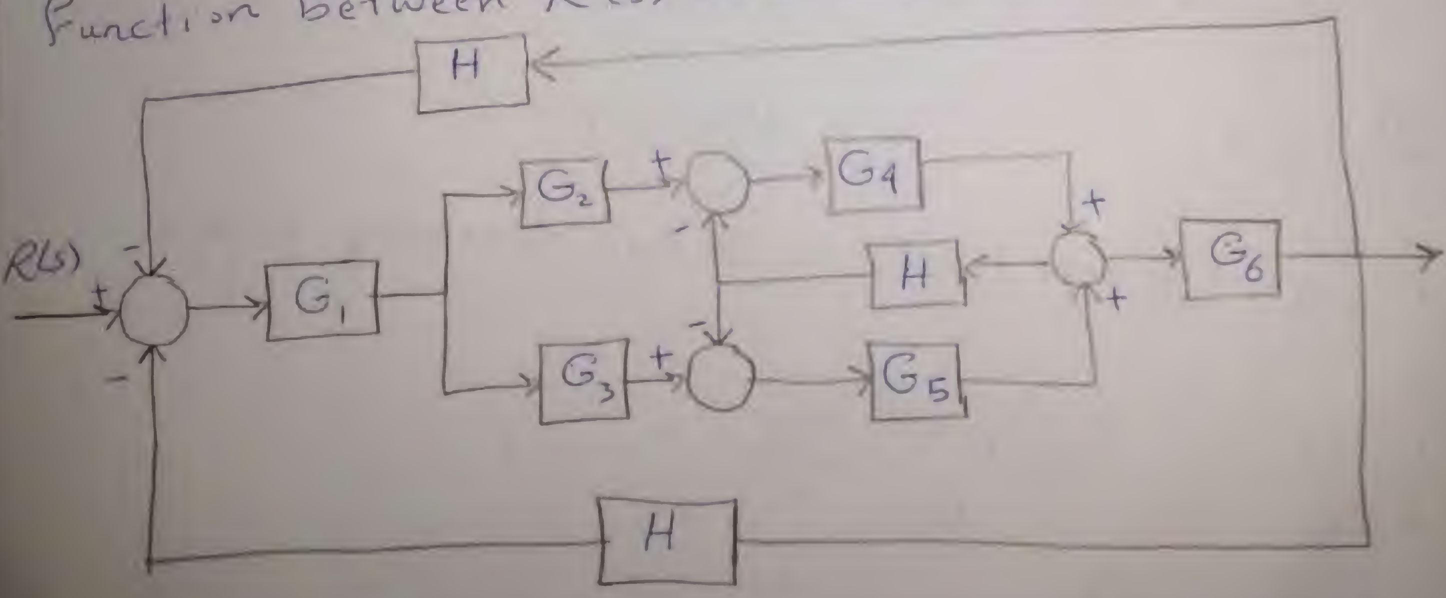
→ Non touching loops → $= 0$

$\Delta_1 = 1$ $\Delta_2 = 1$

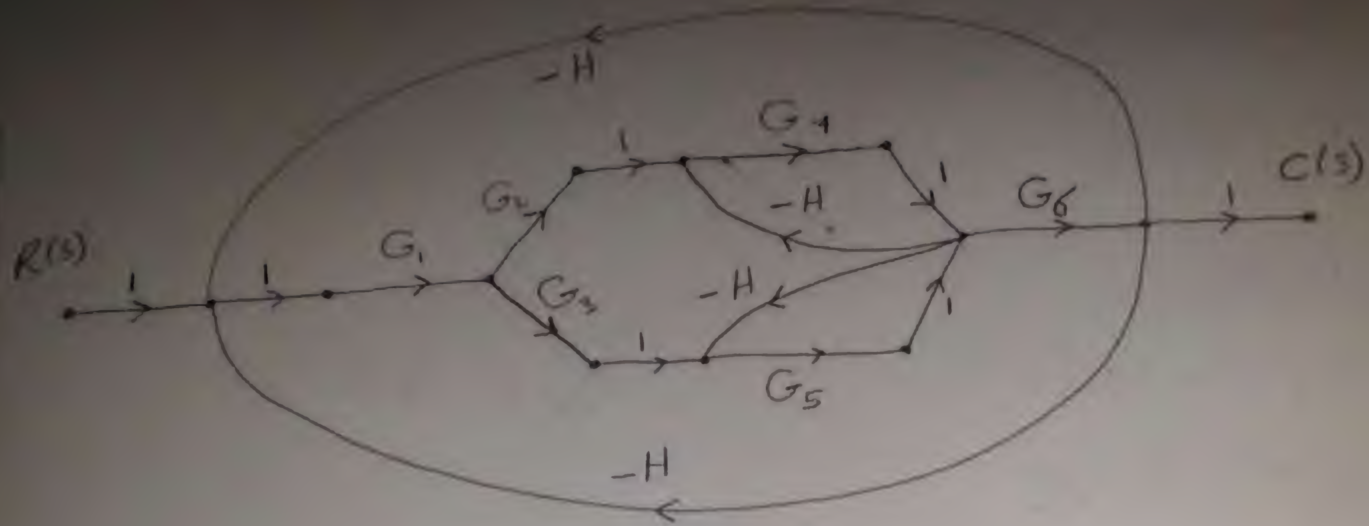
$\Delta = 1 + G_1 G_2 H_3 + G_1 H_1 + G_1 H_2$

$$\frac{C(s)}{R(s)} = \frac{P_1 \Delta_1 + P_2 \Delta_2}{\Delta}$$

$\boxed{3}$ use Mason's gain rule to determine the transfer function between R(s) and C(s)



$\boxed{4}$ sheet 5



Forward Paths

$P_1 = G_1 G_2 G_4 G_6$ $\qquad$ $P_2 = G_1 G_3 G_5 G_6$

Loops

$L_1 = -G_4 H$ $\qquad$ $L_2 = -G_5 H$

$L_3 = -G_1 G_2 G_4 G_6 H$ $\qquad$ $L_4 = -G_1 G_3 G_5 G_6 H$

Non touching loops $= 0$

$\Delta_1 = 1$ $\qquad$ $\Delta_2 = 1$

$\Delta = 1 - \sum$ all loops $+ \sum$ non touching loops.

$$\frac{C(s)}{R(s)} = \frac{P_1 \Delta_1 + P_2 \Delta_2}{\Delta}$$

$\boxed{5}$ sheet 5